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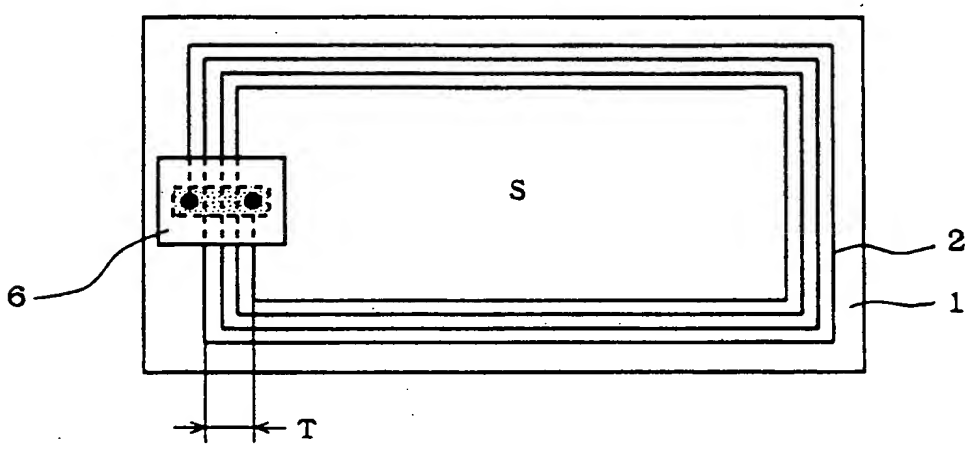
(54) Non-contact IC card and process for its production

(57) In a non-contact IC card comprising a substrate and provided thereon at least an IC chip and an antenna coil formed by etching, a connecting terminal of the antenna coil and a connecting bump of the IC chip are interconnected in a face-down fashion via an anisotropic conductive adhesive layer, or interconnected by wire bonding.

Fig. 1A



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the antenna coil and a connecting bump of the IC chip are interconnected in a face-down fashion via an anisotropic conductive adhesive layer.

The present invention also provides a non-contact IC card that transfers information through an induction electromagnetic field serving as a transmission medium;

the non-contact IC card comprising a substrate and provided thereon at least an IC chip and an antenna coil formed by etching; wherein a connecting terminal of the antenna coil and a connecting bump of the IC chip are interconnected by wire bonding.

The present invention still also provides a process for producing a non-contact IC card, comprising the steps of;

forming a resist layer having at least an antenna coil pattern, on a conductive layer provided on an insulating substrate;

etching the conductive layer, using the resist layer as a mask, to form at least an antenna coil and a connecting terminal thereof;

forming an anisotropic conductive adhesive layer on the connecting terminal of the antenna coil; and

interconnecting the connecting terminal of the antenna coil and a connecting bump of an IC chip in a face-down fashion via the anisotropic conductive adhesive layer.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1A and 1B are a plan view and a partial cross section, respectively, of a basic embodiment of the circuit substrate used in the non-contact IC card of the present invention.

Figs. 2A and 2B are a plan view and a partial cross section, respectively, of another embodiment of the circuit substrate used in the non-contact IC card of the present invention.

Fig. 3 is a partially enlarged view of still another embodiment of the circuit substrate used in the non-contact IC card of the present invention, the view being enlarged at the part in the vicinity of the IC chip.

Figs. 4A and 4B are a plan view and a back view, respectively, of still another embodiment of the circuit substrate used in the non-contact IC card of the present invention.

Figs. 5A and 5B are a plan view and a partial cross section, respectively, of still another embodiment of the circuit substrate used in the non-contact IC card of the present invention.

Figs. 6A to 6E illustrate a process for producing the non-contact IC card of the present invention.

Fig. 7 illustrates a basic circuit construction of the non-contact IC card.

Fig. 8 illustrates how the IC chip and the antenna coil are interconnected in the conventional non-contact IC card.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the non-contact IC card of the present invention, the connecting terminal of an antenna coil and the connecting bump of an IC chip are interconnected in a face-down fashion via an anisotropic conductive adhesive layer, or interconnected by wire bonding. Hence, the both can be interconnected without use of jumper wires. Moreover, when the anisotropic conductive adhesive is used, a high connection reliability can be achieved and also the connection can be operated with ease, also promising a low material cost. Thus, it is possible to interconnect the antenna coil and the IC chip without making the thickness of the IC card too large, and yet at a high connection reliability and a low production cost.

The present invention will be described in greater detail with reference to the accompanying drawings.

Fig. 1A is a plan view of a basic embodiment of the circuit substrate used in the non-contact IC card of the present invention, and Fig. 1B is a partial cross section of the circuit substrate at its part in the vicinity of the IC chip. This circuit substrate is comprised of an insulating substrate 1, an antenna coil 2 formed on the substrate by etching, and an IC chip 6 connected to them. An anisotropic conductive adhesive layer 5 is formed between the antenna coil 2 and the IC chip 6. It is impossible to use an isotropic conductive adhesive layer in place of the anisotropic conductive layer 5, because of shorting between adjacent antenna coil patterns. Via this anisotropic conductive adhesive layer 5, an inner peripheral side terminal 2a and an outer peripheral side terminal 2b are respectively connected to connecting bumps 6a and 6b of the IC chip. Fig. 2A is a plan view of another embodiment of the circuit substrate used in the non-contact IC card of the present invention, and Fig. 2B is a partial cross section thereof. In this embodiment of the circuit substrate, the outer peripheral side terminal 2b of the antenna coil formed on the insulating substrate 1 by etching is extended to turn on the side of the inner peripheral side terminal 2a of the insulating substrate through means of via holes Vh1 and Vh2 and a back conductive layer 2c.

The structure as shown in Figs. 1A and 1B or Figs. 2A and 2B makes it possible to interconnect the antenna coil 2 and the IC chip 6 in a face-down fashion without use of jumper wires. Hence, the IC chip can be produced without making the thickness of the IC card too large, and at a high connection reliability and a low production cost. Especially when, as shown in Figs. 1A and 1B, the IC chip 6 is provided in the manner that it stands across the antenna coil in its width direction, the IC chip can be produced using a single-sided copper-clad substrate having a low material cost.

Incidentally, the number of turn of coils, opening area S (Fig. 1A) and coil width T (Fig. 1A) of the antenna coil 2 depends on the carrier wave transmitting-receiving characteristics of the non-contact IC card. Hence, in some cases, the distance between the inner peripheral

well scratch-resistant resin films 10 of polyethylene terephthalate or the like so as to be covered on its both sides. Thus, the non-contact IC card of the present invention can be obtained (Fig. 6E).

The non-contact IC card of the present invention according to the embodiment as shown in Figs. 2A, 2B, 3, 4A and 4B can also be produced by the production process illustrated in Figs. 6A to 6E and by known methods.

For example, the non-contact IC card according to the embodiment of Fig. 3 can be produced specifically in the following way.

First, an antenna coil 2 (22 turns) having a width T of 11 mm is formed on the copper foil of a single-sided copper clad substrate formed of 18 μm thick copper foil and 50 μm thick polyimide film. Here, the width of the antenna coil is partly decreased so as to provide a distance 2t of 4.5 mm between the inner peripheral side terminal 2a and the outer peripheral side terminal 2b.

Next, the anisotropic conductive adhesive is coated on the inner peripheral side terminal 2a and the outer peripheral side terminal 2b.

Next, using an IC chip 6 having connecting bumps 6a and 6b of 150 μm in bump diameter (distance 6t between bumps: 4.5 mm), the connecting bumps 6a and 6b are positionally adjusted so as to correspond to the terminals 2a and 2b of the antenna coil 2, and then bonded thereto by means of a contact bonding device to interconnect the both at a pressure of 11 kg/mm^2 and at a temperature of 170°C.

Next, a core material urethane resin is fed to the surface on the side of the IC chip 6, and the substrate provided with these is held between 18 μm thick polyester films so as to be covered on its both sides, followed by compression pressing at 70°C and 3 kg/mm^2, and then cutting into the desired external shape. Thus, a non-contact IC card of 0.76 mm thick can be obtained.

As described above, according to the present invention, the IC chip and etched antenna coil of a non-contact IC card can be interconnected without making the thickness of the non-contact IC card too large, and yet at a high reliability and a low production cost.

In a non-contact IC card comprising a substrate and provided thereon at least an IC chip and an antenna coil formed by etching, a connecting terminal of the antenna coil and a connecting bump of the IC chip are interconnected in a face-down fashion via an anisotropic conductive adhesive layer, or interconnected by wire bonding.

Claims

1. A non-contact IC card that transfers information through an induction electromagnetic field serving as a transmission medium;

   said non-contact IC card comprising a substrate and provided thereon at least an IC chip and an antenna coil formed by etching; wherein a connecting terminal of said antenna coil and a connecting bump of said IC chip are interconnected in a face-down fashion via an anisotropic conductive adhesive layer.

2. The non-contact IC card according to claim 1, wherein said IC chip is provided in the manner it stands across the antenna coil.

3. The non-contact IC card according to claim 2, wherein at least part of said antenna coil is decreased in width so that the distance between the connecting terminal on the inner peripheral side and the connecting terminal on the outer peripheral side of said antenna coil is substantially the same as the distance between the connecting bumps of said IC chip which are connected with the terminals.

4. The non-contact IC card according to any one of claims 1 to 3, wherein a tuning capacitor which constitutes an resonance circuit, and a voltage smoothing capacitor are provided within the area of the IC chip.

5. The non-contact IC card according to any one of claims 1 to 3, wherein a tuning capacitor which constitutes an resonance circuit, and/or a voltage smoothing capacitor is/are provided on the substrate separately from said IC chip, and these capacitors are formed by etching.

6. A non-contact IC card that transfers information through an induction electromagnetic field serving as a transmission medium;

   said non-contact IC card comprising a substrate and provided thereon at least an IC chip and an antenna coil formed by etching; wherein a connecting terminal of said antenna coil and a connecting bump of said IC chip are directly interconnected by wire bonding.

7. The non-contact IC card according to claim 6, wherein said IC chip is provided in the manner it stands across the antenna coil.

8. The non-contact IC card according to claim 7, wherein at least part of said antenna coil is decreased in width so that the distance between the connecting terminal on the inner peripheral side and the connecting terminal on the outer peripheral side of said antenna coil is substantially the same as the distance between the connecting bumps of said IC chip which are connected with the terminals.

9. The non-contact IC card according to any one of claims 6 to 8, wherein a tuning capacitor which constitutes an resonance circuit, and a voltage smooth-

Fig. 1A

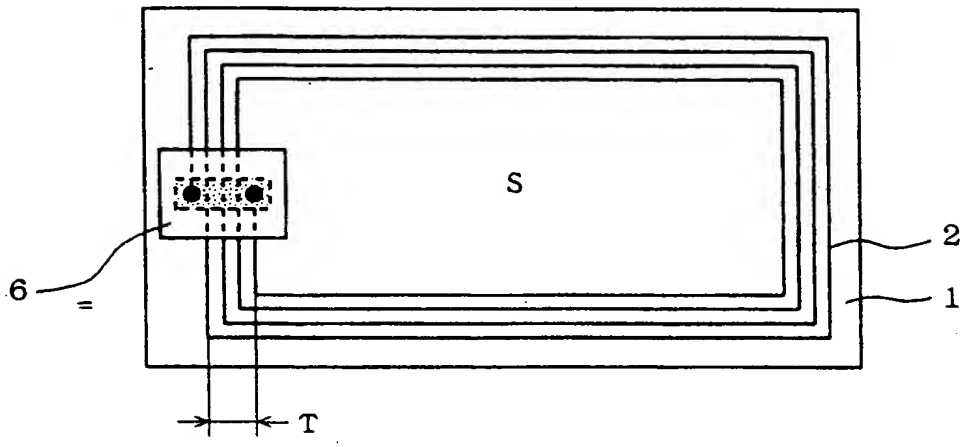

Fig. 1B

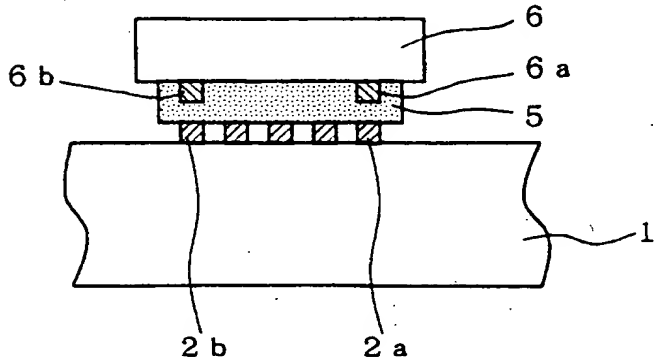

Fig. 3

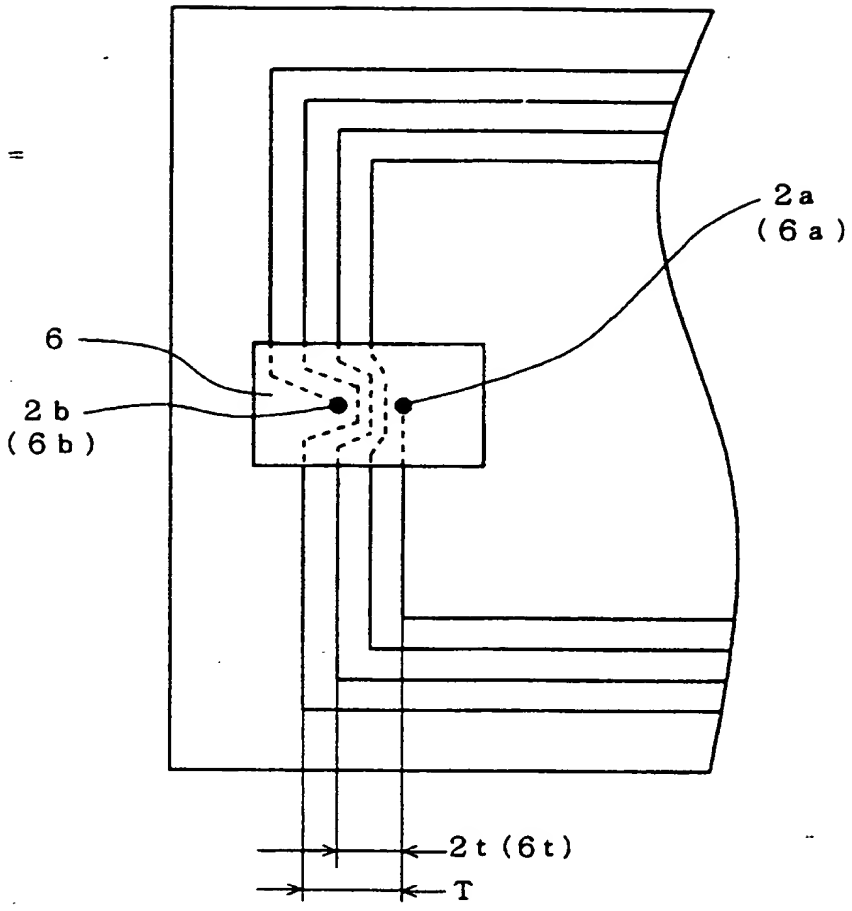

Fig. 5A

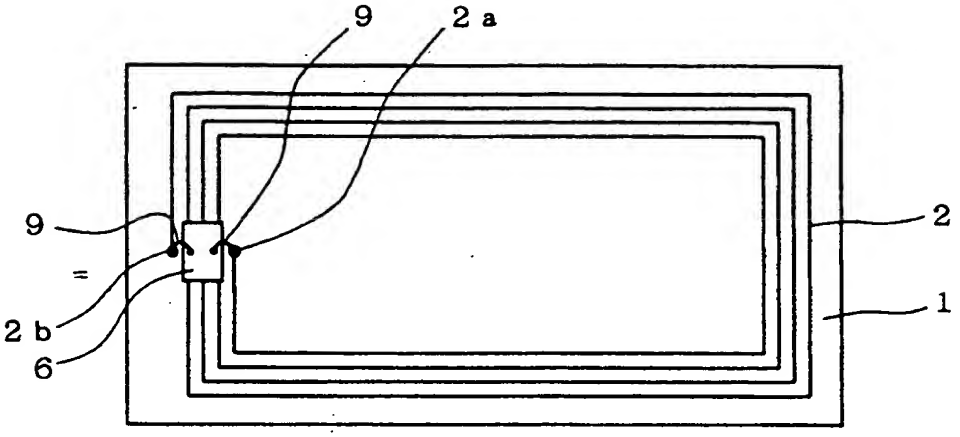

Fig. 5B

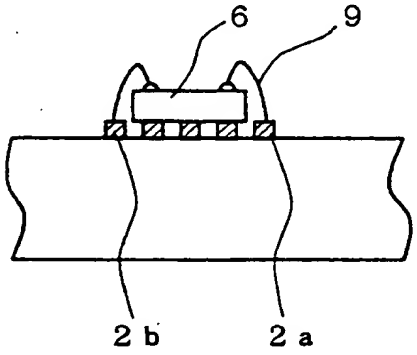

Fig. 7

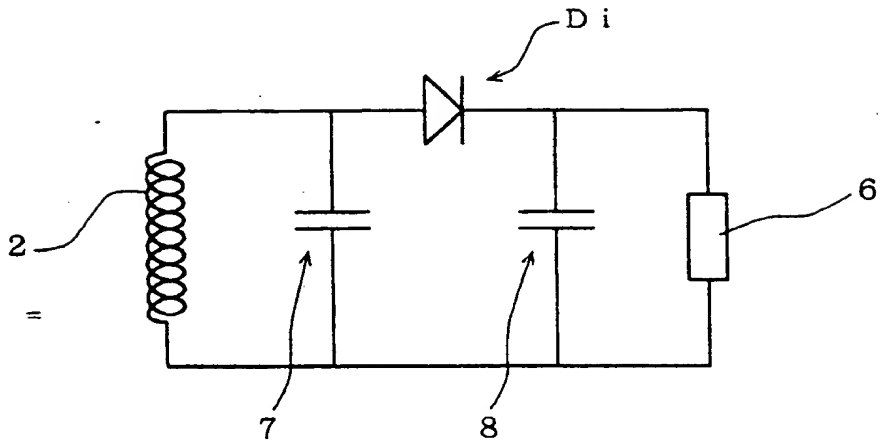

Fig. 8